

## **Fiber Reinforced Plastic (FRP) -- Pollution Prevention Opportunities**

### **Reasons To Reduce**

The fiber reinforced plastics (FRP) industry is a source of hazardous chemicals and volatile organic compound (VOC) emissions released to the environment. Styrene (the volatile component of polyester resin and gel coat ) is the largest contributor to VOC emissions from a FRP facility. Styrene is listed as a hazardous air pollutant (HAP) under the Clean Air Act. Also, mold liquid release wax may contain toluene, catalysts may contain dimethyl phthalate and resins may contain methyl methacrylate. Acetone (clean tools, mixing buckets and other surfaces contaminated with resin) is a hazardous flammable substance which may increase fire insurance premiums.

### **Substitution Considerations**

No single option is likely to replace the plant-wide use of a solvent or completely eliminate the source of VOC emissions. Alternatives that use several options should be carefully considered. When a substitution is being considered, keep in mind the following:

- 9 Will a new waste stream be created /how handled?
- 9 Do new materials pose a worker or safety risk?
- 9 What will be the effect on product quality/production?
- 9 What industry experience exists with the alternative?
- 9 What employee training will be required to implement?
- 9 What are the "Community Right-To-Know" requirements?

### **Reducing Acetone Emissions**

Acetone is used to clean tools because it works well, it is low in toxicity and it is one of the lowest priced solvents available. However, large evaporation losses and the need to handle sent acetone, acetone contaminated rags and distillation bottoms as hazardous waste may reduce profits. Make sure to review and then minimize your acetone vapor losses. Keep all lids and parts drums closed except when in use. Acetone substitutes may reduce cost and emissions. Acetone substitutes are grouped into two general categories:

1. higher-boiling point solvents
2. aqueous cleaners

### **Higher-Boiling Solvents**

These solvents work the same way that acetone does by dissolving resin, except that they do not evaporate as readily. Higher-boiling solvents can be substituted for acetone in many applications, but their effectiveness as a cleaner needs to be verified for each different cleaning situation. Also, carefully review the material safety data sheet (MSDS) to note any potential safety or worker exposure hazards. Protective equipment such as splash goggles and gloves may be necessary.

### **Examples of higher-boiling point solvents include:**

1. ReEntry (terpene)
2. ShipShape (n-methyl pyrrolidone), and

3. DBE (dibasic ester)

4. Diacetone alcohol (DAA)

Contact your chemical supplier for suggestions.

### **Aqueous Cleaners**

Aqueous cleaners rely on mechanical action (such as brushing) to clean resin from contaminated surfaces. The mechanical action used with aqueous cleaners separates the resin so that the resin droplets can be wetted by the aqueous cleaner. This allows the coated resin to settle to the bottom of the cleaning tank. A stream of air can then be used to dry the tool prior to reuse.

Aqueous cleaners are effective substitutes, but special attention needs to be given to training employees in using a new cleaning procedure. Lack of training can result in a lack of acceptance of the new procedures by employees, which can ultimately cause the attempt to fail.

### **Examples of aqueous emulsifying cleaners are:**

1. Thermaclean (aliphatic ester), and

2. Replacetone (glycol methyl ether)

These cleaners are typically purchased as concentrates and diluted on-site to a concentration suitable for a particular situation .

Although aqueous cleaners eliminate VOC' s, they create two other waste streams; (1) the spent aqueous solution and (2) the under-cured resin material that collects at the bottom of the cleaning tank. In Arizona, small batches of under-cured resin can be hardened by adding catalyst.

### **Reducing Styrene Emissions**

Styrene emissions are mostly influenced by application method, amount of overspray, material flow rate, styrene content, gel time, and temperature.

### **Mechanical Application**

Styrene emissions can be reduced by applying resin without spraying. Techniques include flow applicators, pressure fed rollers and filament winding (for tanks).

### **Better Spray Control**

Over pressurized spray guns and operator overspray are major contributors to styrene emissions. Optimization of spray gun set-up and spraying technique should be the first line of pollution prevention while providing cost savings. Facilities should implement a controlled spraying program consisting of three elements which function together to increase transfer efficiency. All three elements should be put in place.

1. Spray gun pressure calibration: Used to determine the minimum fluid tip pressure for any combination of spray equipment, materials or condition.

2. Operator training: Outlines methods for spray gun handling and application techniques focused on reducing overspray and increasing transfer efficiency.

3. Overspray Containment Flanges: Add mold perimeter flanges that limit off-spray from the edge of the mold. These can be built into the mold, or consist of removable masking around the perimeter.

A good source of technical information includes the Composite Fabricators Association website at: [www.cfa-hq.org/techsvcs.htm](http://www.cfa-hq.org/techsvcs.htm) which includes a "Controlled Spaying Training Program and an "Instructor's Guide."

### **Vapor Suppressed Resins**

The use of vapor suppressants is an effective styrene emissions reduction technique. Vapor suppressed resins cannot be used in all applications. These resins contain a wax-like additive that migrates to the surface of the laminate during the cure step, forming a barrier that inhibits the release of styrene. These resins have had a limited acceptance because the waxy barrier has the potential to inhibit bonding of subsequent layers. However the bond strength can be improved by lightly sanding the surface of the cured parts prior to applying the next laminate layer.

### **Low-styrene Resins**

Styrene content is a contributor to overall styrene emissions. A facility may be able to use reduced styrene content resin to reduce emissions. Remember that styrene formulations are driven by finished product requirements. Therefore, low styrene resins can be used in some applications but are not acceptable in others.

### **Mold Waxes**

Paste and liquid waxes may contain mineral spirits (stoddard solvent), toluene, isopropanol alcohol, naphtha, xylene, or trimethylbenzenes which become air emissions or may contaminate rags. Some of these products are self stripping and some are not. The actual % wax blends in these products vary. It is important to review the MSDS to determine the amount of these chemicals incorporated. Possible substitutions may be coming on the market which may be discussed with your supplier.

In order to be used in the fabrication of products, the liquid resin and other ingredients must be mixed with a catalyst to initiate polymerization into a solid thermoset. The various ingredients retain their chemical structure until the catalyzing agent is introduced. Once the chemical reaction has occurred, the new matrix releases no regulated emissions.

### **Resin Catalyst**

Catalyst concentrations may range from 1 to 2 percent by original weight of resin. Cooler winter temperatures may require use of more catalyst. Common catalysts are organic peroxides, typically methyl ethyl ketone peroxide (MEKP) or benzoyl peroxide. MEKP is the most common catalyst. MEKP is a strong oxidizer. Since pure MEKP is shock sensitive, commercial products are typically diluted with 40% dimethyl phthalate, cyclohexane peroxide, or diallyl phthalate to reduce

sensitivity to shock. MEKP is incompatible with very strong acids, bases, and oxidizers. Users should be aware of these chemicals in a catalyst but substitutions for these chemicals appear not to be available.

## **Resources**

A good source of information for is the Fiberglass Fabrication Industry Northwest- Pollution Prevention and Regulatory Perspectives, located on the internet at:  
<http://www.pprc.org/pprc/sbap/fiber/intro.html>

This online "living document", includes information about the state of the industry, current regulatory issues, P2 technologies, innovative research activities, case studies and vendors of P2 equipment. Since this document is not static and virtually "lives", each section in the Table of Contents is updated every 90 days. The updates come from a pre-qualified network of contributors (regional and national), which includes regulators, technical assistance providers, non-governmental organizations, industry representatives and others who have expertise in regulatory and pollution prevention implementation for this industry.